

ORIGINAL ARTICLE

Open Access



Does newborn hearing screening cause anxiety among mothers? A cross-sectional study from a tertiary hospital in Malaysia

Rafidah Mazlan^{1,2*} and Nur Farahain Abdul Razak¹

Abstract

Background The universal newborn hearing screening (UNHS) has effectively allowed babies with hearing loss to be detected early. However, findings from previous studies indicate that this procedure may adversely induce anxiety among mothers. Therefore, this study aimed to investigate anxiety among mothers whose babies received a hearing screening at a tertiary hospital in Malaysia. A cross-sectional study was conducted on 105 mothers from a tertiary hospital in Kuala Lumpur, Malaysia. Two questionnaires, the Infant Health Concern Scale (IHCS) and State-Trait Anxiety Inventory (STAI), were used to measure the mothers' worry level on a 4-point Likert scale. Mothers were required to complete the questionnaires twice, before and 4 weeks after discharge, regardless of the hearing screening results.

Results The STAI scores obtained from mothers whose babies failed the initial screening were significantly higher than mothers whose babies passed. During the initial screening, all mothers rated hearing as the sixth health aspect causing anxiety using the IHCS. However, the ranking fell to 15th place after the second screening. Similarly, mothers whose babies had false positive results also exhibited significantly higher STAI scores and a dropped hearing ranking during rescreening than the initial screening. In addition, mother's anxiety was not significantly correlated with their education level, family income, or number of births.

Conclusion Mothers who participated in this study experienced anxiety regardless of their babies hearing screening results. Therefore, the UNHS program must be reviewed to identify appropriate strategies to minimize this negative emotion among mothers.

Keywords Anxiety, Mothers, Universal newborn hearing screening

Background

Screening babies' hearing through a universal newborn hearing screening (UNHS) program has been widely adopted worldwide as standard care, including

in countries like Malaysia [1]. This program ensures that every baby born with permanent hearing loss is identified by 3 months and receives timely and appropriate intervention before 6 months of age [2]. Consequently, UNHS has effectively improved the language and academic outcomes of children with hearing impairment [3].

Like any other screening program, parental anxiety is the most likely potential harm associated with UNHS [4, 5]. Anxiety has been reported among mothers whose babies failed the initial hearing screening. Previous studies have shown that 4 to 15% of mothers generally and 14 to 25% of mothers whose babies had failed the initial hearing screening were reported to have a high level of anxiety [6–9]. One of the studies mentioned that

*Correspondence:

Rafidah Mazlan
rafidahmazlan@ukm.edu.my

¹ Audiology Programme, Center for Rehabilitation & Special Needs Studies, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia

² Center for Ear, Hearing and Speech, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Kuala Lumpur, Malaysia

the anxiety level rose to 21% after the babies failed the rescreening [8]. Likewise, Tuller and White [10] reported that 14.6% of 192 mothers of babies screened in 11 hospitals in Utah, USA, worried about their infant's hearing following the initial screening. Six weeks later, the same group of mothers readministered the State-Trait Anxiety Inventory (STAI)—short form, and the findings showed that 4.3% of them continued to worry about their infant's hearing. This study also found that hearing was the sixth health condition to cause worry among mothers whose babies received the initial screening, and the rank dropped to the eighth place when remeasured using the Infant Health Concern Scale (IHCS) at the second screening 6 weeks later.

Besides measuring the level of worry, past studies found that mothers' education, number of births, language ability, marital status, and race were factors affecting maternal anxiety towards the UNHS [11, 12]. For instance, Vohr et al. [12] reported that mothers who are primigravida (first birth), bilingual, single, non-Caucasian, and have low education experienced increased levels of anxiety.

The findings above pointed out that some mothers are experiencing anxiety following their babies' hearing screening. This situation may impair the ability of some parents to support their child's care [13]. Therefore, the present study aimed to measure the level of maternal anxiety associated with UNHS conducted in a tertiary hospital in Malaysia. Specifically, the present study aimed to (1) compare the level of anxiety between mothers whose babies passed and mothers whose babies failed the initial hearing screening test, (2) compare maternal anxiety among mothers whose babies had false positive results, (3) compare mothers' anxiety about hearing with 20 other aspects of infant health and behaviour, and (4) determine the association between maternal demographic characteristics and anxiety.

Methods

Participants

This cross-sectional study recruited 500 mothers whose babies had undergone hearing screening between February 1, 2018, and April 30, 2018, at a tertiary hospital in Kuala Lumpur, Malaysia. Participants were selected from mothers from each delivery ward who had yet to be discharged during the study period. Only mothers with healthy post-partum infants were included. Foreign mothers and those whose babies were admitted to the neonatal intensive care unit (NICU) were excluded from the study. This study was approved by the Human Ethics Committees of the Universiti Kebangsaan Malaysia (UKM PPI/111/8/JEP-2017-758) and was

carried out following the Declaration of Helsinki. All participants voluntarily participated and provided written informed consent.

Instruments

The study used two sets of Malay questionnaires, the short version of the STAI [14] and the ICHS [15]. The STAI questionnaire demonstrated good internal consistency with a Cronbach's alpha of 0.94 and 0.84 for the state and anxiety subscale, respectively [16]. The reliability of the Malay-ICHS was determined by determining the Cronbach's alpha obtained from 105 mothers who answered the questionnaire during the initial screening. The Cronbach's alpha coefficient for ICHS was 0.93. Thus, this alpha coefficient exceeded the recommended minimum of 0.70, as suggested by Nunnally and Berstein [17].

The short version of the STAI questionnaire contains six items for respondents to indicate their state of emotion (i.e., calm, tense, upset, relaxed, content, and worried) when the study was taking place using a four-point Likert (1 = not at all to 4 = very much). A mean score is derived by summing up the scores of all six items, multiplying the total score by 20, and dividing by six, with a score above 37 indicating anxiety [14].

The other questionnaire, the ICHS measures participants' level of worry about 21 aspects of infant health and behavior (e.g., eating habits, temperament, eyesight, hearing, and body weight) on a four-point Likert scale (1 = not at all worried to 4 = very worried). Mean scores for each aspect are calculated, with higher scores indicating greater anxiety [15].

Procedure

All mothers were invited to complete a two-phase questionnaire regardless of their babies' hearing screening result, the first phase during the hospital stay before discharge and the second at approximately 4 weeks after the first screening. On the day of the screening, an information sheet, a consent form, and the questionnaires were distributed to mothers at every delivery ward as hard copies following the completion of the screening by a dedicated nurse who performed the hearing screening. Mothers returned the consent form and the questionnaires to the matron of each delivery ward before the discharge. These documents were collected weekly by one of the research members. Four weeks later, when rescreening was usually completed, mothers were contacted again through email by the research team and given a link to an online questionnaire form to complete the study's second phase.

Statistical analysis

All statistical analyses were conducted using SPSS v.25.0 (SPSS Inc., Chicago, Illinois), with statistical significance evaluated using two-sided p values at the 5% testing level. Descriptive statistics such as the mean, median, frequency, and standard deviation were calculated. A Mann–Whitney U test was used to compare the STAI score obtained from mothers whose babies passed and mothers whose babies failed the first hearing screening. A paired sample t test was used to compare maternal anxiety among mothers whose babies had false positive results. Another non-parametric statistical analysis, Wilcoxon signed-rank test, was applied to compare maternal anxiety about hearing with 20 other aspects of infant health and behavior during both phases. Analysis of Spearman's correlation was done to establish an association between mothers' demographic characteristics with the level of anxiety.

Results

One hundred five mothers consented in phase 1, giving a response rate of 21%. Of those were 16 mothers whose babies failed the initial hearing screening and 89 mothers whose babies passed. Phase 2 comprised 25 mothers whose babies passed the initial screening and five mothers whose babies failed the first screening but passed the second screening (false positive results). Mothers' demographic data are presented in Table 1.

The median score of STAI for 105 participants was 33.3 ($SD \pm 13.0$). To compare the level of anxiety during phase 1 between mothers whose babies passed the initial hearing screening and those whose babies failed, the STAI scores were measured and analyzed using Mann–Whitney. The anxiety level of mothers whose babies failed the first hearing screening (median = 60.0) was found to be significantly higher than those of mothers whose babies passed (median = 30.0), $U = 67.5$, $***P < 0.001$. Twenty-eight mothers (27.7%) had STAI scores above 37. Of the 28, 18 (50.0%) were from mothers whose babies passed and 10 (38.5%) from those whose babies failed the hearing screening.

A paired sample t test was used to compare the STAI score among mothers whose babies had a false positive result. The analysis showed a significant increase in the level of anxiety among mothers whose babies had false

positive results during rescreening ($M = 45.8$, $SD = 9.23$) compared to the initial screening ($M = 89.8$, $SD = 5.3$), $t(4) = 5.58$, $***P < 0.001$.

To compare the level of maternal anxiety about hearing with 20 other aspects of infant health and behavior during both phases, the mean for all IHCS health aspects was calculated by summing up the responses and dividing by the number of respondents. The descriptive results of IHCS performed at the initial screening (phase 1) and rescreening (phase 2) are tabulated in Table 2.

In general, mothers were somewhat worried about any of the 21 IHCS aspects of health, where the mean level of anxiety was 2.36 ± 0.83 (refer to Table 2). The highest mean anxiety at phase 1 was having a critical disease (3.18 ± 1.04), with about 71% of mothers reporting being moderately or very worried about this aspect. Hearing was rated as the sixth health aspect that caused anxiety among 48% of the mothers during the initial screening behind getting a critical disease, not waking up from sleep, digestion, getting enough fluid, and bowel movement. Moreover, the mean level for the hearing item was not statistically different from 12 of the other aspects of infant development. During rescreening (phase 2), hearing dropped to 15th place as the health aspect that caused anxiety, and it was not statistically significantly different from 17 other health aspects. The percentage of mothers who were moderately or very worried dropped to 33%.

Among the mothers whose babies had false positive results, the hearing was ranked the second and the eighth health aspect to cause anxiety during the initial screening and rescreening, respectively. By percentage terms, 75% of mothers reported having at least moderate stress during phase 1. This percentage dropped to 60%, with 3 out of 5 mothers experiencing moderate to high anxiety during phase 2. The mean level of hearing in both phases was not statistically significant from 20 other aspects of infant development.

Participants' education, number of births for mothers, and family income were compared with the STAI score to establish demographic characteristics affecting maternal anxiety. Spearman's rho indicated that mothers' education ($r = 0.097$, $p = 0.327$), number of births ($r = 0.097$, $p = 0.344$), and family income ($r = -0.152$, $p = 0.121$)

Table 1 Participants' demographic and socioeconomic variables ($N = 105$)

Race, n (%)	Academic level, n (%)	Family income, n (%)	Number of births turn, n (%)
Malay, 90 (85.7)	Secondary, 31 (29.5)	\leq RM5000, 69 (65.7)	Primigravida, 33 (31.4)
Chinese, 11 (10.5)	Tertiary, 74 (70.5)	$>$ RM5000, 36 (34.3)	Multigravida, 72 (68.6)
Others, 4 (3.8)			

Table 2 Mean level of anxiety on IHCS items and frequencies of mothers “moderately worried” or “very worried” measured at phase 1 ($n = 105$) and phase 2 ($n = 30$)

Aspect of infant health	Mean (SD)		Percent moderately worried or very worried	
	Phase 1	Phase 2	Phase 1	Phase 2
Getting a critical disease	3.18 (1.04)	2.70(0.95)	70.5 (74)	56.7 (17)
Not waking up from sleep	2.78 (1.06)	2.57 (0.86)	57.1 (60)	53.3 (16)
Digestion	2.55 (0.94)	2.47 (0.73)	48.6 (51)	46.7 (14)
Getting enough fluid	2.52 (0.98)	2.27 (0.98)	49.5 (52)	43.3 (13)
Bowel movement	2.50 (1.05)	2.10 (0.99)	47.6 (50)	33.3 (10)
Hearing	2.50 (1.14)	2.03 (1.03)	47.6(50)	33.3 (10)
Ability to pay attention	2.49 (0.98)	2.03(0.85)	48.6 (51)	30.0 (9)
Crying, irritability	2.41 (1.00)	2.30 (0.92)	43.8 (46)	36.7 (11)
Eyesight	2.39 (1.10)	2.10 (1.06)	41.0 (43)	36.7 (11)
Eating habits	2.38 (1.02)	2.00 (0.87)	41.9 (44)	30.0 (9)
Sleeping habits	2.33 (0.88)	2.13 (0.78)	38.1 (40)	30.0 (9)
Intelligence	2.33 (1.02)	2.13 (0.86)	39.0 (41)	30.0 (9)
Physical growth	2.31 (1.07)	1.97 (0.93)	39.0 (41)	26.7 (8)
Recognizing you	2.24 (1.03)	2.10 (0.96)	38.1 (40)	36.7 (11)
Lungs working right	2.22 (1.05)	2.23 (0.94)	35.2 (37)	36.7 (11)
Heart function	2.20 (1.12)	2.30 (0.92)	34.3 (36)	36.7 (11)
Recognizing objects	2.19 (1.09)	1.90 (0.96)	35.2 (37)	26.7 (8)
Ability to move/grasp	2.15 (1.04)	1.80 (0.85)	33.3 (35)	26.7 (8)
Making sound	1.99 (0.96)	1.00 (0.96)	23.8 (25)	26.7 (8)
Weight	1.94 (0.86)	2.07 (0.87)	24.8 (26)	33.3 (1)
Temperament	1.91 (0.88)	2.13 (0.86)	21.0 (22)	30.0 (9)
Average	2.36 (0.30)	2.11 (0.33)	40.0 (42)	33.3 (1)

were not correlated with the level of anxiety experienced by the mothers.

Discussion

This study aimed to measure anxiety among mothers whose babies have had their hearing screened at a tertiary hospital in Malaysia. Generally, the mean anxiety level for mothers during the initial hearing screening measured using STAI was in the normal range. This finding was consistent with Crockett et al.'s study [9], which reported the mean STAI score ranging from 31 to 32 among mothers, regardless of the screening results. Although the mean STAI score in this study was in the normal range, the percentage of mothers who felt moderately worried or very worried about their babies' hearing during the initial hearing screening measured was much higher, reaching 48% when compared to other health aspects using IHCS. This finding differs from previous studies [6–9], in which around 4 to 15% of mothers were moderately worried or very worried about their baby's hearing shortly after birth. Yet, as expected, the

high percentage found among mothers during the initial screening dropped to 33% during rescreening. When comparing all 21 infant health aspects to determine the aspect that causes anxiety among mothers, hearing was ranked sixth during the initial screening but dropped to 15th place during rescreening. Both these results suggested that newborn hearing screening may create moderate to high anxiety levels among almost half of the total mothers during the initial screening, irrespective of the hearing test outcome. Compared to other aspects of infant health and behavior, hearing did not cause the utmost anxiety, and during phase 2, it became the least worrying aspect.

The present study's findings contrasted with Crockett et al.'s [9] when a comparison of maternal anxiety between mothers whose babies passed and mothers whose babies failed the initial screening was conducted. These authors found an increase but insignificant STAI scores among mothers from the two groups. However, this study showed a significant difference in anxiety levels among the two groups, with a higher mean STAI score reported for mothers whose babies failed than those who passed the initial screening rescreening.

On the other hand, among mothers whose babies had false positive results, it was found that the STAI score was significantly higher during the initial screening compared to rescreening. This finding is consistent with Md Daud et al.'s study [6], which showed that 92% of their mothers experienced anxiety during the initial screening compared to 82% during the rescreening. Increasing alertness among mothers to check up on their child's responsiveness towards sounds at home may contribute to such findings.

Newborn hearing screening indeed causes high anxiety to most mothers whose babies had false positive results. After the babies failed the first screening, 75% of mothers reported having moderate or high levels of anxiety. Hearing was ranked the second aspect to cause the highest level of anxiety after getting a critical disease. After their babies passed the rescreening, 60% of mothers were reported to still have moderate or high levels of worry, although the hearing was only ranked the eighth highest cause of worry. When the hearing was compared with 20 other health aspects, it was shown that newborn hearing screening created concerns among mothers regarding their babies' hearing. This notion was especially true among mothers whose babies failed the first screening to a certain extent. However, the effect was not prolonged because once their babies were reassessed after 4 weeks, hearing was no longer among the utmost worrying health aspects. Thus, it is safe to say that newborn hearing screening does not cause long-term maternal anxiety. This finding is consistent with Tueller and White [10],

who concluded that newborn hearing screening programs did not cause undue anxiety because most mothers were more worried about other health and behavioral aspects than hearing.

It is of concern that mothers whose babies had a false positive result experienced significantly greater anxiety than mothers whose babies passed the first screening. It would cause even more concern if mothers continued to be worried that their children might have hearing problems, despite test results showing otherwise. Although this was not the case in this study, the former issue should be addressed. As found in the study, mothers' demographic characteristics did not correlate with anxiety, which differs from Vohr et al.'s study [12]. A possible reason for such a case could be the mothers' lack of understanding towards the UNHS program. Crocket et al. [9] reported that mothers did not understand that referral to diagnostic testing does not necessarily mean their babies have hearing loss and thus worry needlessly. Another possibility to contribute to this understanding among mothers is the knowledge of the attending screeners regarding the UNHS program. It is crucial that screeners are knowledgeable so that, in turn, they can provide mothers with the correct understanding of the program. However, a study by Goedert et al. [18] showed that 78.6% of midwives did not see parental anxiety as a significant challenge in the UNHS program. It is suggested that the potential effect of maternal anxiety should be included during the training for the screeners.

Study limitations

The limitation of this study was the low response rate during rescreening, probably due to the method in distributing the questionnaire through email. It is suggested that the participants' access to the Internet should be ascertained if email or online forms are used to distribute questionnaires for future studies.

Conclusions

The results of the current study suggest that the UNHS program can elicit anxiety in mothers whose babies failed the initial hearing screening and require rescreening. Moreover, mothers whose babies had false positive results experienced more significant anxiety. But when comparing all 21 infant health and behavioral aspects, generally, hearing was not the aspect that caused the most anxiety in mothers due to the dropped ranking during rescreening. However, minimizing this negative emotion is necessary for the UNHS program in the study because of its higher prevalence in the study.

Abbreviations

UNHS	Universal newborn hearing screening
STAI	State-Trait Anxiety Inventory
ICHS	Infant Health Concern Scale

Acknowledgements

We thank the parents who participated in the study and the hospital staff for helping us during the data collection phase.

Authors' contributions

RM contributed to the study design, supervision, analyses, and critical revision of the draft. NFAR participated in the data collection, analysis, and drafting of the manuscript. All authors have read and approved the final version of the manuscript.

Funding

There are no financial conflicts of interest to disclose.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the Research Ethics Committee of Universiti Kebangsaan Malaysia (UKM PPI/111/8/JEP-2017-758). The research was conducted ethically, with all study procedures being performed in accordance with the requirements of the World Medical Association's Declaration of Helsinki. Informed written consent was obtained from all participants in the study. For subjects who were under 16 years old, informed written consent for participation in the study was obtained from their parents or legal guardians.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Received: 13 June 2023 Accepted: 25 August 2023

Published online: 12 October 2023

References

1. Wong YA, Mazlan R, Abdul Wahab NA, Ja'afar R, Bani NH, Abdullah N (2019) Quality measures of a multicentre universal newborn hearing screening program in Malaysia. *J Med Screen* 8: 238-243
2. Joint Committee on Infant Hearing (2019) Year 2019 position statement: principles and guidelines for early hearing detection and intervention program. *J Early Hear Detect Interv* 4:1-44
3. Ching TYC, Dillon H, Leigh G, Cupples L (2018) Learning from the longitudinal outcomes of children with hearing impairment (LOCHI) study: summary of 5-year findings and implications. *Int J Audiol* 57:S105-S111
4. Alan S, Alpar SE (2020) Maternal anxiety associated with newborn screening. *Clin Exp Health Sci* 1:46-53
5. Yoshinaga-Itano C, Manchaiah V, Hunnicutt C (2021) Outcomes of universal newborn hearing screening programs: systematic review. *J Clin Med* 10:2784
6. Md Daud MK, Kamaruddin NR, Affzal A, Abd Rahman N, Mansor S, Zakaria MN (2011) Anxiety of the mothers with referred baby during universal newborn hearing screening. *Int J Pediatr Otorhinolaryngol* 75:513-517
7. Clemens CJ, Davis SA, Bailey AR (2000) The false-positive in universal newborn hearing screening. *Pediatr* 106:e7
8. Weichbold V, Welzl-Mueller K (2001) Maternal concern about positive test results in universal newborn hearing screening. *Pediatr* 108:1111-1116

9. Crockett R, Wright AJ, Uus K, Bamford J, Marteau TM (2006) Maternal anxiety following newborn hearing screening: the moderating role of knowledge. *J Med Screen* 13:20–25
10. Tueller SJ, White KR (2016) Maternal anxiety associated with newborn hearing screening. *J Early Hear Detect Interv* 1:87–92
11. Brand HJ, Coetzer MA (1994) Parental response to their child's hearing impairment. *Psychol Rep* 75:1363–1368
12. Vohr BR, Letourneau KS, Mcdermott C (2001) Maternal worry about neonatal hearing screening. *J Perinatol* 21:15–20
13. Rosenberg RE, Clark P, Chibbaro HR, Hambrick BA, Bruzzese JM, Feudtner C, Mendelsohn A (2017) Factors predicting parent anxiety around infant and toddler postoperative pain. *Hosp Ped* 7:313–319
14. Marteau TM, Bekker H (1992) The development of a six-item short-form of the state scale of the Spielberger State-Trait Anxiety inventory (STAI). *Br J Clin Psychol* 31:301–306
15. Tueller S (2006) Maternal worry about infant health, maternal anxiety, and maternal perceptions of child vulnerability associated with newborn hearing screen results (Unpublished master's thesis). Utah State University, Logan
16. Hashim E, Hasyila WW, Ang Y, Helmy AA, Husyairi H (2018) Psychometric properties of the Malay translated Spielberger State-Trait anxiety inventory in exploring parental anxiety. *Med Health* 13:106–116
17. Nunnally J, Bernstein L (1994) *Psychometric theory*. McGraw-Hill Higher, New York
18. Goedert MH, Moeller MP, White KR (2011) Midwives' knowledge, attitudes, and practices related to newborn hearing screening. *J Midwifery Women's Health* 56:147–153

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Submit your manuscript to a SpringerOpen[®] journal and benefit from:

- ▶ Convenient online submission
- ▶ Rigorous peer review
- ▶ Open access: articles freely available online
- ▶ High visibility within the field
- ▶ Retaining the copyright to your article

Submit your next manuscript at ► [springeropen.com](https://www.springeropen.com)
